

## \* NOTICES \*

(F5)

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

Bibliography

---

- (19) [Country of Issue] Japan Patent Office (JP)
- (12) [Official Gazette Type] Open patent official report (A)
- (11) [Publication No.] JP,2001-304263,A (P2001-304263A)
- (43) [Date of Publication] October 31, Heisei 13 (2001. 10.31)
- (54) [Title of the Invention] Liquid bearing equipment
- (51) [The 7th edition of International Patent Classification]

F16C 33/10  
17/02

[FI]

F16C 33/10        Z  
17/02            A

[Request for Examination] Un-asking.

[The number of claims] 6

[Mode of Application] OL

[Number of Pages] 7

(21) [Filing Number] Application for patent 2000-121861 (P2000-121861)

(22) [Filing Date] April 24, Heisei 12 (2000. 4.24)

(71) [Applicant]

[Identification Number] 000005821

[Name] Matsushita Electric Industrial Co., Ltd.

[Address] 1006, Kadoma, Kadoma-shi, Osaka

(72) [Inventor(s)]

[Name] Hirata Katsushi

[Address] 8-1, Furujimmachi, Takamatsu-shi, Kagawa-ken A Matsushita-Kotobuki Electronics Industries stock meeting in the company

(74) [Attorney]

[Identification Number] 100068087

[Patent Attorney]

[Name] Morimoto Yoshihiro

[Theme code (reference)]

3J011

[F term (reference)]

3J011 AA06 AA12 CA02 EA04 JA02 KA02 MA04

---

[Translation done.]

## \* NOTICES \*

Japan Patent Office is not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

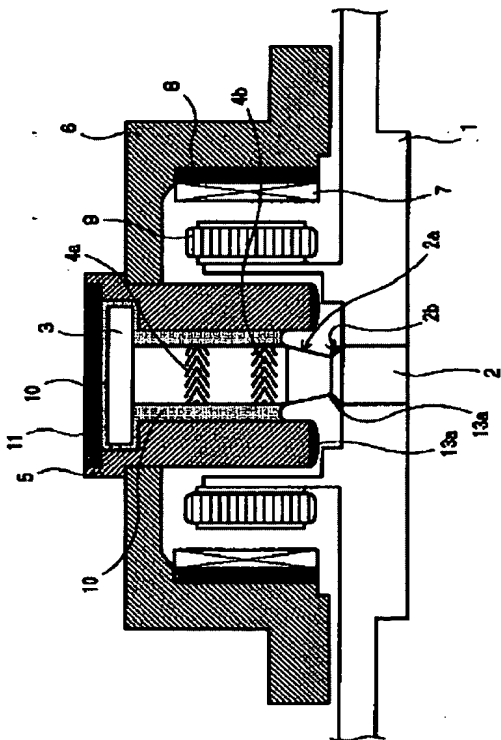
## Epitome

### (57) [Abstract]

[Technical problem] Recognition by viewing of an oil repellent agent is enabled, positive formation of an oil-repellent film can be performed, and the liquid bearing equipment which can prevent leakage of lubricant is offered.

[Means for Solution] It is filled up with lubricant 10 between a shank 2 and body of revolution 5, and oil-repellent film 13a which prevents leakage of lubricant 10 is formed near the liquid junction side of lubricant 10. In a different color from a shank 2 or body of revolution 5 in which oil-repellent film 13a was formed, or the same color, it is colored a color from which a shade differs and this oil-repellent film 13a is made identifiable.

[Translation done.]



[Translation done.]

### \* NOTICES \*

Japan Patent Office is not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

CLAIMS

---

## [Claim(s)]

[Claim 1] The liquid-bearing equipment which is the liquid-bearing equipment formed the oil-repellent film which is filled up with lubricant between body of revolution supported by a shank and this shank free [ a revolution ], and prevents leakage of said lubricant to a shank or body of revolution near a liquid-junction side of said lubricant, and constituted said oil-repellent film so that it colors the color from which a shade differs in a different color from a shank or body of revolution in which said oil-repellent film was formed, or the same color and it may become identifiable.

[Claim 2] Liquid bearing equipment which is the liquid bearing equipment in which an oil-repellent film which is filled up with lubricant between body of revolution supported free [ a revolution ], and prevents leakage of said lubricant by shank and this shank to a shank or body of revolution near a liquid junction side of said lubricant was formed, and formed a level difference in a front face of said oil-repellent film.

[Claim 3] Liquid bearing equipment according to claim 2 which formed a level difference for said oil-repellent film as a multilayer configuration more than a bilayer.

[Claim 4] Liquid-bearing equipment which was the liquid bearing equipment in which an oil-repellent film which is filled up with lubricant between body of revolution supported free [ a revolution ], and prevents leakage of said lubricant by shank and this shank to a shank or body of revolution near a liquid junction side of said lubricant was formed, and colored each class a color from which a shade differs in a different color or the same color while forming a level difference for said oil-repellent film as a configuration more than a bilayer.

[Claim 5] Said oil-repellent film is liquid bearing equipment according to claim 1 to 4 which contained a coloring material to resin which is a principal component.

[Claim 6] Liquid bearing equipment according to claim 5 which contained one [ at least ] component of a pigment or a color in said coloring material.

---

[Translation done.]

## \* NOTICES \*

Japan Patent Office is not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

DETAILED DESCRIPTION

---

## [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the liquid bearing equipment of the dynamic pressure mold used for the spindle motor of a magnetic disk drive etc.

[0002]

[Description of the Prior Art] Drawing 4 shows conventional liquid bearing equipment. The end of the fixed shaft 2 with which the dynamic pressure generating slots 4a and 4b were formed in the peripheral face is pressed fit in the base 1, a thrust plate 3 is fixed to the other end, and the shank is formed.

[0003] The sleeve 5 is pressed fit in the inner skin of the hub 6 for attaching a magnetic disk etc., the thrust flange 11 is attached in the end of this sleeve 5, and body of revolution is formed.

[0004] And the fixed shaft 2 is inserted in the bearing hole of a sleeve 5 so that the thrust flange 11 and a thrust plate 3 may counter, it fills up with lubricant 10 between a shank and body of revolution, and body of revolution is supported by the shank free [ a revolution ].

[0005] Moreover, a stator coil 9 is formed in the wall formed in the base 1, the Rota magnet 7 and the Rota yoke 8 are attached in an opposed face with the stator coil 9 of a hub 6, and the motorised section is

constituted.

[0006] If a sleeve 5 and a hub 6 carry out revolution actuation by this motorised section, dynamic pressure will occur to lubricant 10 according to a pumping operation of the dynamic pressure generating slots 4a and 4b formed in the fixed shaft 2, and revolution support of a shank and the body of revolution will be carried out by non-contact.

[0007]

[Problem(s) to be Solved by the Invention] Although held inside bearing with surface tension, when lubricant 10 disperses by revolution actuation of bearing equipment or the lubricant 10 with which it filled up between a shank and body of revolution oozes out, it will produce the contamination to a poor revolution and the exterior of bearing.

[0008] In order to prevent leakage of such lubricant 10, the oil-repellent film 14 which has the property which crawls lubricant 10 in the fixed shaft 2 and sleeve 5 near a liquid junction side of lubricant 10 is formed.

[0009] Although the oil-repellent film 14 applies to a need part the oil repellent agent which consists of a fluororesin which crawls lubricant 10, such as a synthetic hydrocarbon oil and an ester system oil, and is formed, the need of forming small quantity in a minute field at high degree of accuracy is increasing with a miniaturization and thin-shape-izing of information recording devices including a magnetic disk drive in recent years.

[0010] However, in needing the special recognition equipment which the oil repellent agent of a fluororesin system is transparent and colorless, recognition by viewing at the time of spreading is difficult since it is moreover formed several micrometers or less in the shape of a thin film, and used the laser beam etc., automation is not progressing, either.

[0011] Therefore, an oil repellent agent flows into the impregnation range of lubricant 10, and there is a problem of fluctuation of the holding power of lubricant 10 and the instability of the pumping force arising, and lubricant 10 dispersing to the exterior of bearing equipment by un-putting the oil-repellent film 14, or oozing out.

[0012] This invention solves said trouble and recognition by viewing of an oil repellent agent is enabled, and positive formation of an oil-repellent film is performed and it aims at offering the liquid bearing equipment which can prevent leakage of lubricant.

[0013]

[Means for Solving the Problem] Liquid bearing equipment of this invention is characterized by coloring it an oil-repellent film. According to this this invention, recognition by viewing in a covering region and an interface of an oil-repellent film is attained, and leakage of lubricant by un-forming [ of a pressure fluctuation by influx for a lubricant attaching part and an oil-repellent film of an oil repellent agent ] can be reduced.

[0014]

[Embodiment of the Invention] The liquid bearing equipment of this invention according to claim 1 is filled up with lubricant between the body of revolution supported by a shank and this shank free [ a revolution ]. It is the liquid bearing equipment in which the oil-repellent film which prevents leakage of said lubricant to the shank or body of revolution near a liquid junction side of said lubricant was formed. It is characterized by constituting so that said oil-repellent film may be colored the color from which a shade differs in a different color from the shank or body of revolution in which said oil-repellent film was formed, or the same color and it may become identifiable.

[0015] According to this configuration, without specifying the covering region of an oil-repellent film with processing or masking, according to the color difference of the formation part of the oil-repellent film with which it was colored, and an agensis part, and a shade difference, a covering region and an interface become clear, and recognition by viewing of an oil-repellent film can be realized easily, and can reduce an influx for the lubricant attaching part of an oil repellent agent, and the leakage of lubricant.

[0016] The liquid bearing equipment of this invention according to claim 2 is the liquid bearing equipment in which the oil-repellent film which is filled up with lubricant between the body of revolution supported free [ a revolution ], and prevents leakage of said lubricant by the shank and this shank to the shank or body of revolution near a liquid junction side of said lubricant was formed, and is characterized by forming a level difference in the front face of said oil-repellent film.

[0017] According to this configuration, the leakage control of higher lubricant is obtained. The liquid bearing equipment of this invention according to claim 3 is characterized by forming a level difference for said oil-repellent film as a multilayer configuration more than a bilayer in claim 2.

[0018] The liquid bearing equipment of this invention according to claim 4 is filled up with lubricant between the body of revolution supported by a shank and this shank free [ a revolution ]. It is the liquid bearing equipment in

which the oil-repellent film which prevents leakage of said lubricant to the shank or body of revolution near a liquid junction side of said lubricant was formed, and while forming a level difference for said oil-repellent film as a configuration more than a bilayer, it is characterized by coloring each class the color from which a shade differs in a different color or the same color.

[0019] According to this configuration, since the covering region and interface of an oil-repellent film can identify easily visually according to the color difference and the shade difference of each class, a multilayer level difference configuration can be recognized certainly, and the leakage control effect of clearer lubricant is acquired.

[0020] It is characterized by the liquid bearing equipment of this invention according to claim 5 containing a coloring material in either claim 1 - claim 4 to the resin said whose oil-repellent film is a principal component. According to this configuration, the additional activity of spreading of a coloring material, blasting, etc. is not needed, but simple and positive coloring can be realized.

[0021] The liquid bearing equipment of this invention according to claim 6 is characterized by containing one [ at least ] component of a pigment or a color in said coloring material in claim 5. According to this configuration, the class of coloring material added according to the dispersibility of the pigment to the coating solution which dissolves the resinous principle of an oil-repellent film, or the solubility of a color can be chosen, and efficient uniform coloring is obtained.

[0022] Hereafter, the gestalt of each operation of this invention is explained using drawing 1 - drawing 3 based on an example. In addition, the same sign is attached and explained to what makes the same configuration as drawing 4 which shows the above-mentioned conventional example.

[0023] (Gestalt 1 of operation) Drawing 1 shows the (gestalt 1 of operation) of this invention. In the gestalt of this operation, while coloring it oil-repellent film 13a, it differs from the above-mentioned conventional example at the point which made special the configuration of the end face section of the fixed shaft 2.

[0024] Taper section 2a and 2b are formed in the end face section of the fixed shaft 2 in the liquid bearing equipment specifically constituted like drawing 4 which shows the above-mentioned conventional example. Moreover, in the conventional transparent and colorless oil-repellent film 14, it differs in the end face and taper section 2b of a sleeve 5 near a liquid junction side of lubricant 10, and colored oil-repellent film 13a is formed in them.

[0025] This oil-repellent film 13a is formed in the black fluororesin system oil repellent agent which contained carbon black so that it could discriminate from the fixed shaft 2 of metal colors, such as silver and copper color, or a sleeve 5.

[0026] As fluorine system resin which forms oil-repellent film 13a Pori ethylene-tetrafluoroethylene copolymer (ETFE), vinyl fluoride (PVF) Polyvinylidene fluoride (PVDF), an ethylene-chlorotrifluoroethylene copolymer (ECTFE), A polychlorotrifluoroethylene resin (PCTFE) and tetrafluoroethylene-perfluoroalkyl vinyl ether copolymer (PFA), A polytetrafluoroethylene (PTFE) and tetrafluoroethylene-hexafluoropropylene copolymer (FEP) etc. may be mentioned and the part may be replaced by functional groups, such as a hydroxyl group, a carboxyl group, an amino group, an isocyanate radical, and an epoxy group. The crystalline or amorphous perfluoro resin system which has lower surface energy especially can use it suitably especially.

[0027] Carbon black is distributed as a pigment at homogeneity in the coating solution which dissolves the above-mentioned fluorine system resin, and oil-repellent film 13a is formed by applying to taper section 2b of the soffit side of a sleeve 5, and the fixed shaft 2.

[0028] The formation method of oil-repellent film 13a can choose a spin coat, a DIP coat, a spray coat, an imprint coat, a potting coat, brush coating, etc. as arbitration according to the magnitude and the configuration of a member.

[0029] With the liquid bearing equipment constituted as mentioned above, the covering region and interface of oil-repellent film 13a can identify oil-repellent film 13a clearly visually according to the color difference of the formation part of oil-repellent film 13a, and an agenesis part, without specifying the covering region of oil-repellent film 13a with processing or masking, since it is colored black so that it can discriminate from the fixed shaft 2 and a sleeve 5.

[0030] Consequently, automation by the image processing by the CCD image sensor also becomes possible. Moreover, since the location and range of oil-repellent film 13a can control with a sufficient precision, an influx to the impregnation range of the lubricant 10 of an oil repellent agent is prevented, the holding power and the pumping force of lubricant 10 can be held to stability, and reliable liquid bearing equipment is obtained.

[0031] Moreover, since positive covering of an oil repellent agent can be recognized, it can prevent un-forming [ of oil-repellent film 13a ], and the leakage to the bearing exterior of lubricant 10 can be reduced.

Furthermore, scattering and adhesion of the oil repellent agent to parts other than the formation range of oil-

repellent film 13a can also be recognized, and generating of a foreign matter can be reduced.

[0032] In addition, although the above-mentioned explanation gave and explained the example which formed oil-repellent film 13a in the black fluororesin system oil repellent agent, this invention is not limited to this, and if oil-repellent film 13a has the critical surface tension of oil-repellent film 13a smaller than the surface tension of lubricant 10, it can use not only a fluororesin system oil repellent agent but the resin of a silicone resin system oil repellent agent or others that what is necessary is just what crawls lubricant 10.

[0033] Moreover, with a sleeve 5 and the fixed shaft 2, if the color of oil-repellent film 13a is identifiable, it is good and black, and also other colors, such as white, red, blue, and purple, can be substituted for it. Moreover, what is necessary is just to be able to identify according to a shade difference, even if it is the same color as a sleeve 5 or the fixed shaft 2.

[0034] Moreover, an organic pigment, an inorganic pigment, and a color are mentioned as a coloring material used for coloring. As an organic pigment, a phthalocyanine system, the Quinacridone system, a horse mackerel lake system, an anthraquinone system compound, etc. are used, and titanium oxide, a zinc oxide, lead oxide, chrome oxide, an iron oxide, phosphoric-acid cobalt, etc. can be used other than above-mentioned carbon black as an inorganic pigment.

[0035] Moreover, as a color, an anthraquinone system, an azo system compound, etc. can be used and these may be fluorinated selectively. By distributing, or dissolving and using it at homogeneity at the coating solution which dissolves a resinous principle, the additional activity of spreading of a coloring material, blasting, etc. does not need a coloring material as mentioned above, but simple and positive coloring can be realized.

[0036] If the above-mentioned coloring material is a range where it distributes or dissolves in the coating solution which dissolves the above-mentioned resinous principle at homogeneity, and the oil repellency of oil-repellent film 13a or the adhesion of oil-repellent film 13a and a coating member does not produce lowering by deterioration or gasification of a coloring material, it can be chosen as one or more and arbitration according to classes, such as a coating solution and oil-repellent film 13a.

[0037] Moreover, although a dispersant etc. may be added if needed in order to distribute and dissolve a coloring material in homogeneity, it is desirable to make it min as much as possible. In addition, although oil-repellent film 13a was considered as the much more configuration [ try ] in the above-mentioned explanation When a level difference is further formed in the front face of this oil-repellent film 13a as the oil-repellent film of multilayer structure in piles on the surface of *Perilla frutescens* (L.) Britton var. *crispa* (Thunb.) Decne., an oil-repellent film with this level difference When lubricant 10 exceeds the oil-repellent film of an eye further, or even when the oil repellency of the oil-repellent film of an eye falls further, leakage of lubricant 10 is prevented by a bilayer eye and the oil-repellent film of the third layer, and the higher leakage control effect is acquired with them.

[0038] (Gestalt 2 of operation) Drawing 2 and drawing 3 show the (gestalt 2 of operation) of this invention. Drawing 2 shows the configuration of liquid bearing equipment, drawing 3 (a) shows the cross section of the upper part of liquid bearing equipment, and drawing 3 (b) shows a plan.

[0039] this (gestalt 2 of operation) --- \*\*\*\* --- although it differs at the point made into a color which is different in each class by making the oil-repellent film 13 into multilayer structure while considering as the liquid bearing equipment which opened the ends of a sleeve 5 to atmospheric air, the other configuration is the same as that of the above (gestalt 1 of operation).

[0040] As shown in details at drawing 2, a thrust plate 3 is pressed fit in the end face section side of the fixed shaft 2, and the both sides of the bearing hole of a sleeve 5 are opened by atmospheric air. The end face section of the fixed shaft 2 is pressed fit in the base 1, fixed support is carried out at covering which does not illustrate the other end, the taper sections 2c and 2d are formed in the fixed shaft 2 upside, and taper section 2a and 2b are formed in the end face section side. 12 is the labyrinth color 12 pressed fit in the sleeve 5.

[0041] In the liquid bearing equipment constituted as mentioned above, oil-repellent film 13a is formed in the soffit side and taper section 2b of a sleeve 5 by the end face section side of the fixed shaft 2 like the above (gestalt 1 of operation). This oil-repellent film 13a consists of a black fluororesin system oil repellent agent containing carbon black.

[0042] As the fixed shaft 2 upside is shown in drawing 3 (a) and (b), oil-repellent film 13a is formed in 2d of taper sections of the upper bed side of a sleeve 5, and the fixed shaft 2. Moreover, oil-repellent film 13b of still more nearly another class is formed in the front face of oil-repellent film 13a formed in the upper bed side of a sleeve 5, and it has multilayer structure.

[0043] Oil-repellent film 13a of an eye becomes details from the black fluororesin system oil repellent agent which contained carbon black like the gestalt of the above-mentioned implementation further, and oil-repellent film 13b of the bilayer eye formed on it is formed in the white silicone resin system oil repellent agent

containing titanium oxide.

[0044] As silicone resin, silicone resin was mentioned and you may denaturalize by the polyether, the amine, epoxy, alkyd, etc. Thus, since it is colored the respectively different color, in case oil-repellent film 13a and oil-repellent film 13b become identifiable visually, respectively and oil-repellent film 13a and oil-repellent film 13b form oil-repellent film 13b in the front face of oil-repellent film 13a, they can form a level difference A in the front face by the side of the inner circumference of oil-repellent film 13a easily.

[0045] Moreover, further, oil-repellent film 13a of an eye has the property in which the adhesion force is large, and since the oil-repellent force has a large property and has a role with separate each, as for oil-repellent film 13b of a bilayer eye, an oil-repellent film still more highly efficient than the gestalt of the above-mentioned implementation is obtained.

[0046] Therefore, if revolution actuation of a sleeve 5, a hub 6, and the labyrinth color 12 is carried out by the motorised section of liquid bearing equipment, dynamic pressure will occur to lubricant 10 according to a pumping operation of the dynamic pressure generating slots 4a and 4b formed in the fixed shaft 2, and revolution support of the fixed shaft 2 and the sleeve 5 will be carried out by non-contact. Since the oil-repellent film of multilayer structure with which the level difference A was formed as mentioned above is formed in the upper bed side where the insertion hole of a sleeve 5 serves as a opening at this time, rather than the above (gestalt 1 of operation), the dynamic pressure engine performance is stabilized further and the effect of the high leakage control of lubricant 10 is acquired.

[0047] In addition, although the oil-repellent film formed in the upper bed side of a sleeve 5 was made into the two-layer structure in the above-mentioned explanation, in order to make more reliable the effect of preventing leakage, it is good also as a configuration of three or more layers.

[0048] Moreover, if the location which carries out multilayer formation of the oil-repellent film is a part which needs oil repellency, it is not limited to the soffit side of a sleeve 5, and it is good also as the inner skin of a sleeve 5, or a peripheral face of the fixed shaft 2.

[0049] Moreover, what is necessary is not to limit especially the color of each class which carries out multilayer formation, and just to be able to identify it according to the color difference or a shade difference. For example, although oil-repellent film 13b was made white and oil-repellent film 13a was made identifiable with the upper bed side of a sleeve 5 black in the above-mentioned explanation, oil-repellent film 13a may be made into the upper bed side of a sleeve 5, and an identifiable color, and oil-repellent film 13b may be made the configuration of making it the same color as the upper bed side of a sleeve 5.

[0050] furthermore, in case a different component for each class of the oil-repellent film of multilayer structure is carried out For example, the oil-repellent large film of an oil-repellent film, the fixed shaft 2, or the adhesion force with a sleeve 5 is further formed in an eye with many functional groups etc. A more highly efficient oil-repellent film is obtained by complementing the engine performance which was not obtained with one kind of oil-repellent membrane component, such as forming an oil-repellent film with a high degree of hardness, and giving the role of a protective coat after a bilayer eye, and suiting.

[0051] What formed oil-repellent layer 13a of an eye by the amorphous perfluoro resin system further, and specifically formed oil-repellent film 13b of a bilayer eye by the crystalline perfluoro resin system is mentioned.

[0052]

[Effect of the Invention] Positive formation and discernment of an oil-repellent film can be performed, an influx for the lubricant attaching part of an oil repellent agent is reduced, stable dynamic pressure is obtained, and the reliable liquid-bearing equipment which leakage of the lubricant from bearing can prevent good can realize by coloring it the color from which a shade differs and making it identifiable as mentioned above in a color which is different from the formation part of said oil-repellent film on the oil-repellent film which prevents leakage of lubricant according to this invention, or the same color.

[0053] Moreover, since the covering region of an oil repellent agent and an interface become clear and it can recognize easily visually according to the color difference and the shade difference of the formation part of an oil-repellent film, and an agenesis part, if it picturizes and equipments, such as image recognition, are used, spreading and automation of recognition are realizable with a sufficient precision.

[0054] Moreover, the leakage of lubricant can be further reduced by forming a level difference in the front face of said oil-repellent film.

---

[Translation done.]

## \* NOTICES \*

Japan Patent Office is not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

## DESCRIPTION OF DRAWINGS

## [Brief Description of the Drawings]

[Drawing 1] The cross section of the liquid bearing equipment in the (gestalt 1 of operation) of this invention

[Drawing 2] The cross section of the liquid bearing equipment in the (gestalt 2 of operation) of this invention

[Drawing 3] The important section enlarged view in the gestalt of this operation

[Drawing 4] The cross section of conventional liquid bearing equipment

## [Description of Notations]

- 1 Base
- 2 Fixed Shaft
- 2a-2d Taper section
- 4 Dynamic Pressure Generating Slot
- 10 Lubricant
- 13a Fluororesin system oil-repellent film
- 13b Silicone resin system oil-repellent film

[Translation done.]

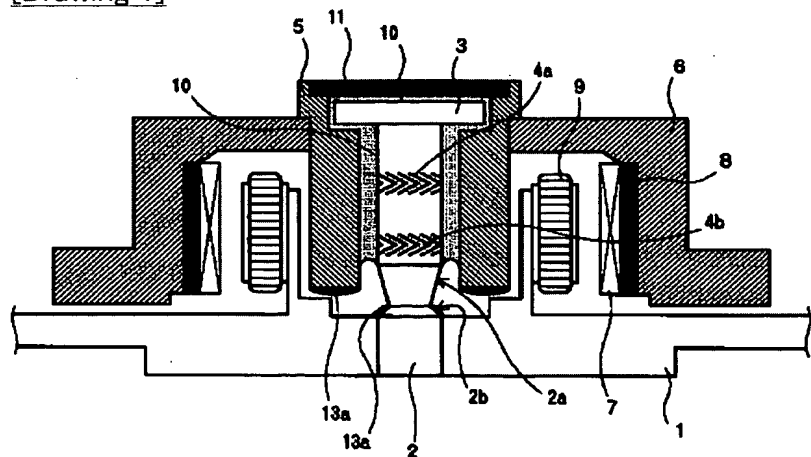
## \* NOTICES \*

Japan Patent Office is not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

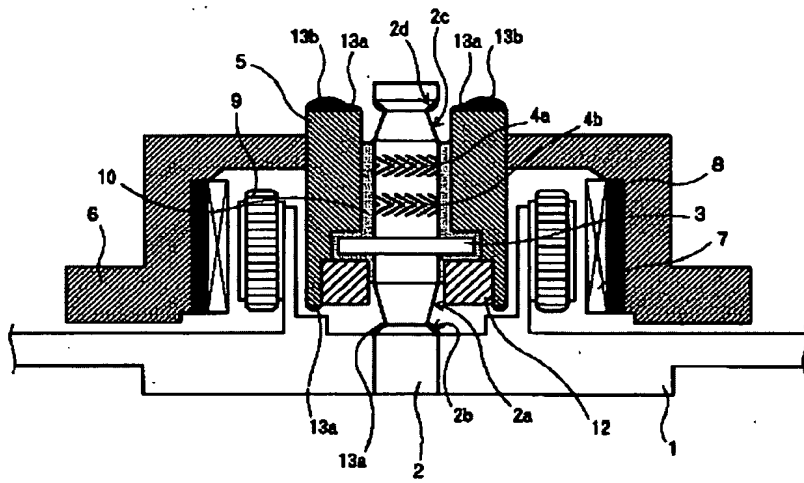
## DRAWINGS

## [Drawing 1]

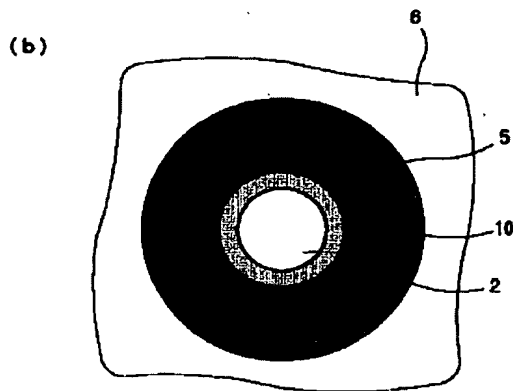
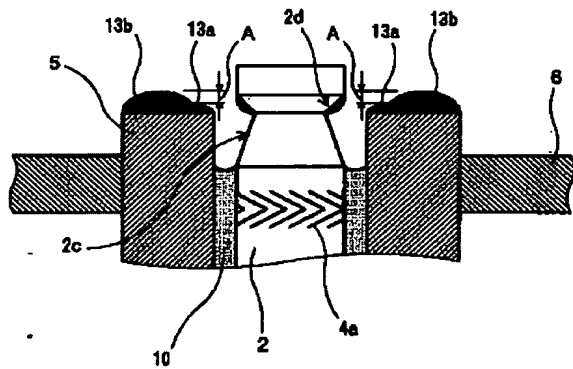


## [Drawing 2]

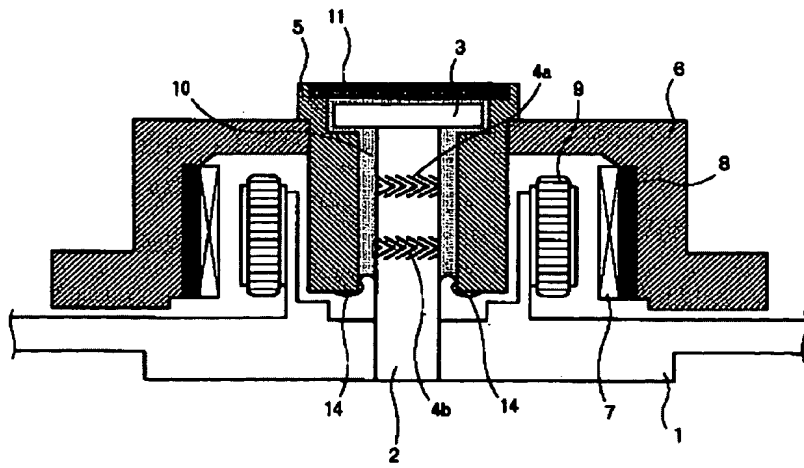




[Drawing 3]  
(a)



[Drawing 4]



[Translation done.]

(19) 日本国特許庁 (J P)

## (12) 公開特許公報 (A)

(11) 特許出願公開番号  
特開2001-304263

(P 2 0 0 1 - 3 0 4 2 6 3 A)

(43) 公開日 平成13年10月31日 (2001. 10. 31)

(51) Int. Cl. <sup>7</sup>  
F16C 33/10  
17/02

識別記号

F I  
F16C 33/10  
17/02

テーマコード (参考)

Z 3J011  
A

審査請求 未請求 請求項の数 6 O L (全 7 頁)

(21) 出願番号 特願2000-121861 (P 2000-121861)

(22) 出願日 平成12年 4 月24日 (2000. 4. 24)

(71) 出願人 000005821

松下電器産業株式会社

大阪府門真市大字門真1006番地

(72) 発明者 平田 勝志

香川県高松市古新町 8 番地の 1 松下寿電  
子工業株式会社内

(74) 代理人 100068087

弁理士 森本 義弘

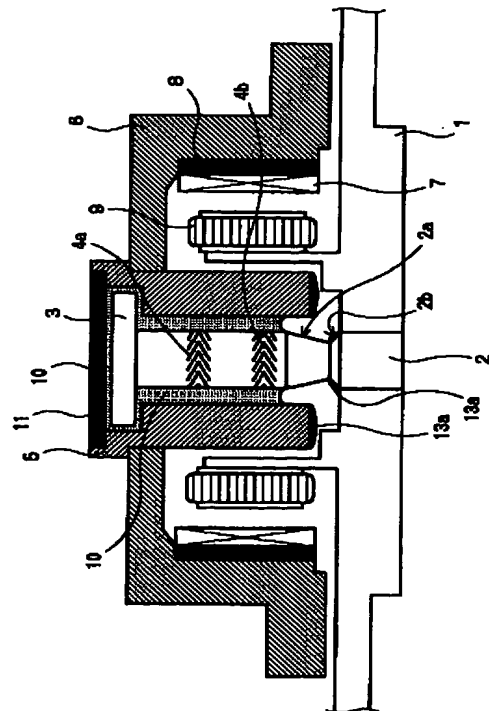
F ターム (参考) 3J011 AA06 AA12 CA02 EA04 JA02  
KA02 MA04

(54) 【発明の名称】 流体軸受装置

(57) 【要約】

【課題】 撥油剤の目視での認識を可能にして撥油膜の確実な形成が行え、潤滑剤の漏洩を防止できる流体軸受装置を提供する。

【解決手段】 軸部 2 と回転体 5 との間に潤滑剤 10 を充填し、潤滑剤 10 の液界面付近に潤滑剤 10 の漏洩を防止する撥油膜 13 a を形成する。この撥油膜 13 a を撥油膜 13 a が形成された軸部 2 もしくは回転体 5 と異なる色または同色で濃淡の異なる色に着色して識別可能にする。



**【特許請求の範囲】**

【請求項 1】軸部とこの軸部によって回転自在に支持された回転体との間に潤滑剤を充填し、前記潤滑剤の液界面付近の軸部もしくは回転体に前記潤滑剤の漏洩を防止する撥油膜を形成した流体軸受装置であって、前記撥油膜を、前記撥油膜が形成された軸部もしくは回転体と異なる色または同色で濃淡の異なる色に着色して識別可能となるよう構成した流体軸受装置。

【請求項 2】軸部とこの軸部によって回転自在に支持された回転体との間に潤滑剤を充填し、前記潤滑剤の液界面付近の軸部もしくは回転体に前記潤滑剤の漏洩を防止する撥油膜を形成した流体軸受装置であって、前記撥油膜の表面に段差を形成した流体軸受装置。

【請求項 3】前記撥油膜を二層以上の多層構成として段差を形成した請求項 2 記載の流体軸受装置。

【請求項 4】軸部とこの軸部によって回転自在に支持された回転体との間に潤滑剤を充填し、前記潤滑剤の液界面付近の軸部もしくは回転体に前記潤滑剤の漏洩を防止する撥油膜を形成した流体軸受装置であって、前記撥油膜を二層以上の構成として段差を形成するとともに、各層を異なる色または同色で濃淡の異なる色に着色した流体軸受装置。

【請求項 5】前記撥油膜は主成分である樹脂に色剤を含有した請求項 1 ～請求項 4 のいずれかに記載の流体軸受装置。

【請求項 6】前記色剤に顔料または染料の少なくとも一方の成分を含有した請求項 5 記載の流体軸受装置。

**【発明の詳細な説明】****【0001】**

【発明の属する技術分野】本発明は、磁気ディスク装置のスピンドルモータなどに用いられる動圧型の流体軸受装置に関するものである。

**【0002】**

【従来の技術】図 4 は従来の流体軸受装置を示す。外周面に動圧発生溝 4 a, 4 b が形成された固定軸 2 の一端がベース 1 に圧入され、他端にはスラストプレート 3 が固定されて軸部が形成されている。

【0003】磁気ディスク等を取り付ける為のハブ 6 の内周面にはスリーブ 5 が圧入されており、このスリーブ 5 の一端にスラストフランジ 11 が取り付けられて回転体が形成されている。

【0004】そして、スラストフランジ 11 とスラストプレート 3 とが対向するようにスリーブ 5 の軸受孔に固定軸 2 が挿入され、軸部と回転体との間には潤滑剤 10 が充填されて回転体が軸部によって回転自在に支持される。

【0005】また、ベース 1 に形成された壁にステータコイル 9 が設けられ、ハブ 6 のステータコイル 9 との対向面にロータマグネット 7 とロータヨーク 8 が取り付けられて、モータ駆動部が構成される。

【0006】このモータ駆動部によりスリーブ 5 及びハブ 6 が回転駆動すると、固定軸 2 に形成された動圧発生溝 4 a, 4 b のポンピング作用により潤滑剤 10 に動圧が発生し、軸部と回転体とが非接触で回転支持される。

**【0007】**

【発明が解決しようとする課題】軸部と回転体との間に充填された潤滑剤 10 は、表面張力によって軸受内部に保持されているが、軸受装置の回転駆動により潤滑剤 10 が飛散したり染み出したりすると軸受の回転不良や外部への汚染を生じることとなる。

【0008】このような潤滑剤 10 の漏洩を防止するため、潤滑剤 10 の液界面付近の固定軸 2 やスリーブ 5 には、潤滑剤 10 をはじく性質を持つ撥油膜 14 が形成されている。

【0009】撥油膜 14 は、合成炭化水素油やエステル系油などの潤滑剤 10 をはじくフッ素樹脂からなる撥油剤を必要個所に塗布して形成されるが、近年の磁気ディスク装置をはじめとする情報記録装置の小型化・薄型化に伴って、微小領域に少量を高精度に形成する必要性が高まっている。

【0010】しかし、フッ素樹脂系の撥油剤は無色透明であり、しかも数  $\mu\text{m}$  以下の薄膜状に形成されるため塗布時の目視での認識が困難であり、レーザ光などを利用した特殊な認識装置を必要とするうえ、自動化も進んでいない。

【0011】そのため撥油剤が潤滑剤 10 の注入範囲へ流れ込んで、潤滑剤 10 の保持力の変動やポンピング力の不安定が生じたり、また、撥油膜 14 の未被着によって潤滑剤 10 が軸受装置の外部へ飛散したりしみ出すという問題がある。

【0012】本発明は前記問題点を解決し、撥油剤の目視での認識を可能にして撥油膜の確実な形成を行い、潤滑剤の漏洩を防止できる流体軸受装置を提供することを目的とする。

**【0013】**

【課題を解決するための手段】本発明の流体軸受装置は、撥油膜に着色を施したことを特徴とする。この本発明によると、撥油膜の被着域や境界面での目視での認識が可能となり、撥油剤の潤滑剤保持部分への流れ込みによる圧力変動や、撥油膜の未形成による潤滑剤の漏れを低減できる。

**【0014】**

【発明の実施の形態】本発明の請求項 1 記載の流体軸受装置は、軸部とこの軸部によって回転自在に支持された回転体との間に潤滑剤を充填し、前記潤滑剤の液界面付近の軸部もしくは回転体に前記潤滑剤の漏洩を防止する撥油膜を形成した流体軸受装置であって、前記撥油膜を、前記撥油膜が形成された軸部もしくは回転体と異なる色または同色で濃淡の異なる色に着色して識別可能となるよう構成したことを特徴とする。

【0015】この構成によると、撥油膜の被着域を加工やマスキングにより規定することなく、着色を施された撥油膜の形成部位と非形成部位の色差、濃淡差によって被着域や境界面が明確になり、撥油膜の目視での認識が容易に実現でき、撥油剤の潤滑剤保持部分への流れ込みや潤滑剤の漏れを低減できる。

【0016】本発明の請求項2記載の流体軸受装置は、軸部とこの軸部によって回転自在に支持された回転体との間に潤滑剤を充填し、前記潤滑剤の液界面付近の軸部もしくは回転体に前記潤滑剤の漏洩を防止する撥油膜を形成した流体軸受装置であって、前記撥油膜の表面に段差を形成したことを特徴とする。

【0017】この構成によると、より高い潤滑剤の漏洩防止が得られる。本発明の請求項3記載の流体軸受装置は、請求項2において、前記撥油膜を二層以上の多層構成として段差を形成したことを特徴とする。

【0018】本発明の請求項4記載の流体軸受装置は、軸部とこの軸部によって回転自在に支持された回転体との間に潤滑剤を充填し、前記潤滑剤の液界面付近の軸部もしくは回転体に前記潤滑剤の漏洩を防止する撥油膜を形成した流体軸受装置であって、前記撥油膜を二層以上の構成として段差を形成するとともに、各層を異なる色または同色で濃淡の異なる色に着色したことを特徴とする。

【0019】この構成によると、各層の色差や濃淡差によって撥油膜の被着域や境界面が目視で容易に識別できるため確実に多層の段差形状が認識でき、より確かな潤滑剤の漏洩防止効果が得られる。

【0020】本発明の請求項5記載の流体軸受装置は、請求項1～請求項4のいずれかにおいて、前記撥油膜は主成分である樹脂に色剤を含有したことを特徴とする。この構成によると、色剤の塗布や吹き付けなどの追加作業を必要とせず、簡易で確実な着色が実現できる。

【0021】本発明の請求項6記載の流体軸受装置は、請求項5において、前記色剤に顔料または染料の少なくとも一方の成分を含有したことを特徴とする。この構成によると、撥油膜の樹脂成分を溶解するコーティング溶液への顔料の分散性や染料の溶解性に応じて添加する色剤の種類を選択でき、効率良く均一な着色が得られる。

【0022】以下、本発明の各実施の形態を具体例に基づき図1～図3を用いて説明する。なお、上記従来例を示す図4と同様の構成をなすものには同一の符号を付けて説明する。

【0023】（実施の形態1）図1は、本発明の（実施の形態1）を示す。この実施の形態では、撥油膜13aに着色を施すとともに固定軸2の基端部の形状を特殊にした点で上記従来例とは異なる。

【0024】具体的には、上記従来例を示す図4と同様に構成された流体軸受装置において、固定軸2の基端部にはテーパ部2a、2bが形成されている。また、潤滑

剤10の液界面付近のスリーブ5の端面とテーパ部2bには、従来の無色透明の撥油膜14とは異なり、着色された撥油膜13aが形成されている。

【0025】この撥油膜13aは、例えば銀色や銅色などの金属色の固定軸2やスリーブ5と識別できるようカーボンブラックを含有した黒色のフッ素樹脂系撥油剤にて形成されている。

【0026】撥油膜13aを形成するフッ素系樹脂としては、エチレン-テトラフルオロエチレン共重合体（ETFE）、ポリフッ化ビニル（PVF）、ポリフッ化ビニリデン（PVDF）、エチレン-クロロトリフルオロエチレン共重合体（ECTFE）、ポリクロロトリフルオロエチレン（PCTFE）、テトラフルオロエチレン-パーフルオロアルキルビニルエーテル共重合体（PFA）、ポリテトラフルオロエチレン（PTFE）、テトラフルオロエチレン-ヘキサフルオロプロピレン共重合体（FEP）などが挙げられ、その一部は水酸基、カルボキシル基、アミノ基、イソシアネート基、エポキシ基などの官能基で置換されていてもよい。中でも、より低い表面エネルギーを持つ結晶性または非晶質のパーフルオロ樹脂系が特に好適に使用できる。

【0027】上記のフッ素系樹脂を溶解するコーティング溶液に顔料としてカーボンブラックを均一に分散し、スリーブ5の下端面および固定軸2のテーパ部2bに塗布することで撥油膜13aが形成される。

【0028】撥油膜13aの形成方法は、スピンコート、ディップコート、スプレーコート、転写コート、ポッティングコート、刷毛塗りなど、部材の大きさや形状に応じて任意に選択できる。

【0029】上記のように構成された流体軸受装置では、撥油膜13aは固定軸2およびスリーブ5と識別できるよう黒色に着色されているため、撥油膜13aの被着域を加工やマスキングにより規定することなく、撥油膜13aの形成部位と非形成部位の色差により、撥油膜13aの被着域や境界面が目視にて明確に識別できる。

【0030】その結果、CCD撮像素子による画像処理による自動化も可能となる。また、撥油膜13aの位置や範囲が精度良く制御できるため、撥油剤の潤滑剤10の注入範囲までの流れ込みを防止して潤滑剤10の保持力やポンピング力を安定に保持でき、信頼性の高い流体軸受装置が得られる。

【0031】また、撥油剤の確実な被着が認識できるため撥油膜13aの未形成が防止でき、潤滑剤10の軸受外部への漏洩を低減できる。さらに、撥油膜13aの形成範囲以外の部位への撥油剤の飛散や付着も認識でき、異物の発生を低減できる。

【0032】なお、上記説明では、撥油膜13aを黒色のフッ素樹脂系撥油剤にて形成した例を挙げて説明したが、本発明はこれに限定されるものではなく、撥油膜13aは潤滑剤10をはじくものであれば良く、撥油膜1

3 a の臨界表面張力が潤滑剤 10 の表面張力より小さければフッ素樹脂系撥油剤だけでなくシリコン樹脂系撥油剤やその他の樹脂も使用できる。

【0033】また、撥油膜 13 a の色はスリーブ 5 や固定軸 2 と識別可能であれば良く、黒色の他にも白色、赤色、青色、紫色など他の色でも代用できる。また、スリーブ 5 や固定軸 2 と同様の色であっても、濃淡差により識別できるものであればよい。

【0034】また、着色に用いる色剤としては、有機顔料、無機顔料、染料が挙げられる。有機顔料としては、フタロシアニン系、キナクリドン系、アジレーキ系、アントラキノン系化合物などが用いられ、無機顔料としては、上述のカーボンブラックの他に、酸化チタン、酸化亜鉛、酸化鉛、酸化クロム、酸化鉄、リン酸コバルトなどが使用できる。

【0035】また、染料としては、アントラキノン系、アゾ系化合物などを用いることができ、これらは部分的にフッ素化されていてもよい。上記のように色剤を樹脂成分を溶解するコーティング溶液に均一に分散または溶解して使用することで、色剤の塗布や吹き付けなどの追加作業が必要とせず、簡易で確実な着色が実現できる。

【0036】上記の色剤は、上記樹脂成分を溶解するコーティング溶液に均一に分散または溶解し、かつ撥油膜 13 a の撥油性または撥油膜 13 a とコーティング部材との密着性が色剤の変質やガス化によって低下を生じない範囲であれば、コーティング溶液や撥油膜 13 a 等の種類に応じて一つ以上、任意に選択できる。

【0037】また、色剤を均一に分散、溶解させるため、必要に応じて分散剤などを添加してもよいが、できる限り最小にすることが望ましい。なお、上記説明では、撥油膜 13 a を一層のみの構成としたが、この撥油膜 13 a の表面にさらに撥油膜を重ねて多層構造の撥油膜としその表面に段差が形成されるようにすると、この段差によって、潤滑剤 10 が一層目の撥油膜を超える場合や一層目の撥油膜の撥油性が低下する場合でも、二層目、三層目の撥油膜によって潤滑剤 10 の漏洩が防止され、より高い漏洩防止効果が得られる。

【0038】（実施の形態 2）図 2 と図 3 は、本発明の（実施の形態 2）を示す。図 2 は流体軸受装置の構成を示し、図 3（a）は流体軸受装置の上部の断面図を、図 3（b）は平面図を示す。

【0039】この（実施の形態 2）では、スリーブ 5 の両端を大気に開放した流体軸受装置とするとともに、撥油膜 13 を多層構造として各層を異なる色にした点で異なるが、それ以外の構成は上記（実施の形態 1）と同様である。

【0040】詳細には、図 2 に示すように、スラストプレート 3 は固定軸 2 の基端部側に圧入され、スリーブ 5 の軸受孔の両側は大気に開放されている。固定軸 2 の基端部はベース 1 に圧入され、他端は図示しないカバーに

固定支持されており、固定軸 2 の上側にはテーパ部 2 c、2 d が形成され、基端部側にはテーパ部 2 a、2 b が形成されている。12 は、スリーブ 5 に圧入されたラビリンスカラー 12 である。

【0041】上記のように構成された流体軸受装置において、固定軸 2 の基端部側は上記（実施の形態 1）と同様に、スリーブ 5 の下端面とテーパ部 2 b に撥油膜 13 a が形成されている。この撥油膜 13 a は、カーボンブラックを含有した黒色のフッ素樹脂系撥油剤からなる。

【0042】固定軸 2 の上側は、図 3（a）、（b）に示すように、スリーブ 5 の上端面と固定軸 2 のテーパ部 2 d に撥油膜 13 a が形成されている。また、スリーブ 5 の上端面に形成された撥油膜 13 a の表面には、さらに別の種類の撥油膜 13 b が形成され多層構造となっている。

【0043】詳細には、一層目の撥油膜 13 a は上記実施の形態と同様にカーボンブラックを含有した黒色のフッ素樹脂系撥油剤からなり、その上に形成された二層目の撥油膜 13 b は酸化チタンを含有した白色のシリコン樹脂系撥油剤にて形成されている。

【0044】シリコン樹脂としては、シリコンレジンが挙げられ、ポリエーテル、アミン、エポキシ、アルキドなどで変性されていてもよい。このように撥油膜 13 a と撥油膜 13 b とはそれぞれ別の色に着色されているため、撥油膜 13 a と撥油膜 13 b とはそれぞれ目視にて識別可能となり、撥油膜 13 a の表面に撥油膜 13 b を形成する際に、撥油膜 13 a の内周側の表面に段差 A を容易に形成できる。

【0045】また、一層目の撥油膜 13 a は密着力が大きい性質を有し、二層目の撥油膜 13 b は撥油力が大きい性質を有し、それぞれが別々の役割を有するため、上記実施の形態よりもさらに高性能な撥油膜が得られる。

【0046】従って、流体軸受装置のモータ駆動部によりスリーブ 5、ハブ 6 およびラビリンスカラー 12 を回転駆動させると、固定軸 2 に形成された動圧発生溝 4 a、4 b のポンピング作用により潤滑剤 10 に動圧が発生し、固定軸 2 とスリーブ 5 とが非接触で回転支持される。このときスリーブ 5 の挿入孔が開口となっている上端面には、上述のように段差 A の形成された多層構造の撥油膜が形成されているため、上記（実施の形態 1）よりもさらに動圧性能が安定し、潤滑剤 10 の高い漏洩防止の効果が得られる。

【0047】なお、上記説明では、スリーブ 5 の上端面に形成された撥油膜を二層構造としたが、漏洩を防止する効果をより確実にするために三層以上の構成としても良い。

【0048】また、撥油膜を多層形成する位置は、撥油性を必要とする部位であればスリーブ 5 の下端面に限定されるのではなく、スリーブ 5 の内周面や固定軸 2 の外周面としてもよい。

10

20

30

40

50

【0049】また、多層形成する各層の色は特に限定されるものではなく、色差や濃淡差により識別できるものであればよい。例えば、上記説明では、撥油膜13aを黒色に撥油膜13bを白色にして、スリーブ5の上端面と識別可能にしたが、撥油膜13aはスリーブ5の上端面と識別可能な色にして撥油膜13bはスリーブ5の上端面と同じ色にするなどの構成にしてもよい。

【0050】さらに、多層構造の撥油膜の各層ごとに異なった成分をさせる際には、例えば、多数の官能基などをもち撥油膜または固定軸2またはスリーブ5との密着力の大きい撥油膜を一層目に形成して、二層目以降に高い硬度を持つ撥油膜を形成して保護膜の役割を与えるなど、一種類の撥油膜成分では得られなかった性能を補完しあうことで、より高性能な撥油膜が得られる。

【0051】具体的には、一層目の撥油層13aを非晶質のパーフルオロ樹脂系にて形成し、二層目の撥油膜13bを結晶性のパーフルオロ樹脂系にて形成したものが挙げられる。

【0052】

【発明の効果】以上のように本発明によれば、潤滑剤の漏洩を防止する撥油膜に前記撥油膜の形成個所と異なる色または同色で濃淡の異なる色に着色して識別可能にすることで、撥油膜の確実な形成および識別が行え、撥油剤の潤滑剤保持部分への流れ込みを低減して安定な動圧

が得られ、軸受からの潤滑剤の漏洩が良好に防止できる信頼性の高い流体軸受装置を実現できる。

【0053】また、撥油膜の形成部位と非形成部位の色差や濃淡差によって、撥油剤の被着域、境界面が明確になり、目視にて容易に認識できるため、撮像して画像認識等の装置を用いれば、精度良く塗布および認識の自動化が実現できる。

【0054】また、前記撥油膜の表面に段差を形成することで、より一層、潤滑剤の漏れを低減できる。

【図面の簡単な説明】

【図1】本発明の（実施の形態1）における流体軸受装置の断面図

【図2】本発明の（実施の形態2）における流体軸受装置の断面図

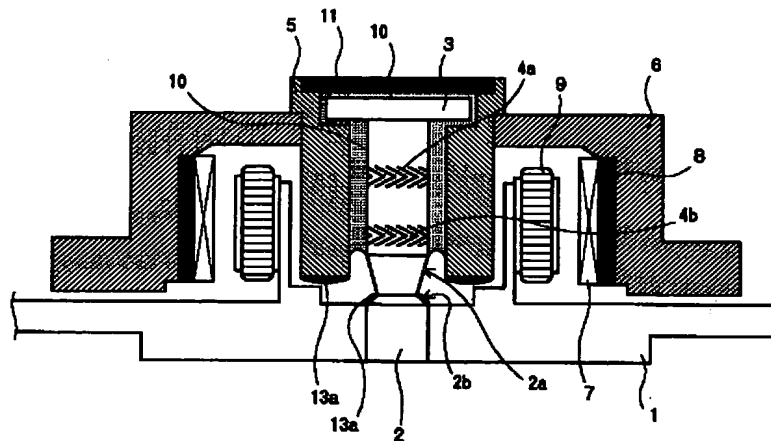
【図3】同実施の形態における要部拡大図

【図4】従来の流体軸受装置の断面図

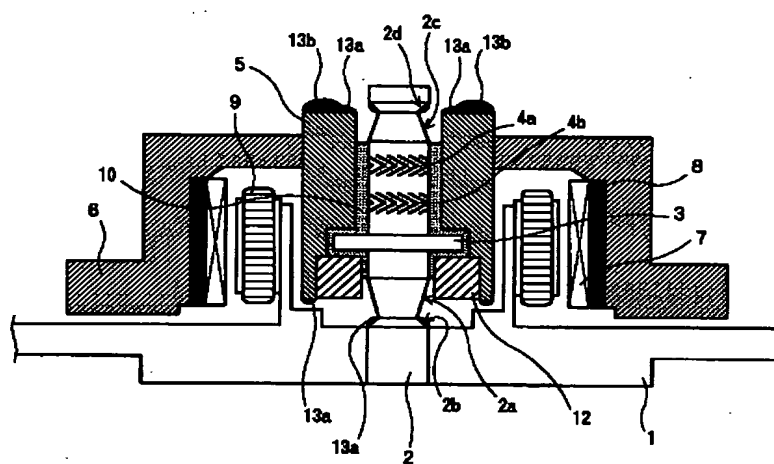
【符号の説明】

- |       |            |
|-------|------------|
| 1     | ベース        |
| 2     | 固定軸        |
| 2a～2d | テーパ部       |
| 4     | 動圧発生溝      |
| 10    | 潤滑剤        |
| 13a   | フッ素樹脂系撥油膜  |
| 13b   | シリコン樹脂系撥油膜 |

【図1】

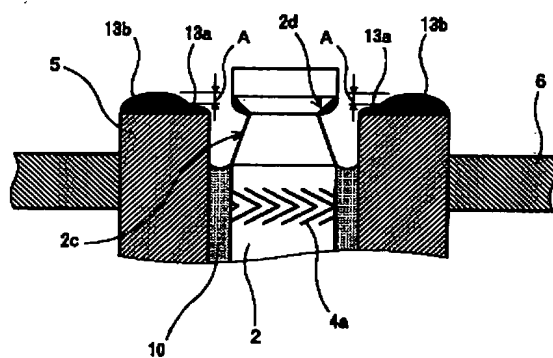


【図 2】

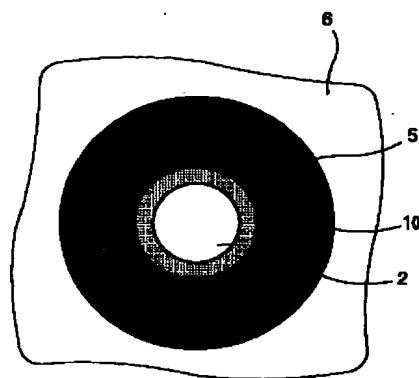


【図 3】

(a)



(b)





【図 4】

